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CRAB LARVAE (Callinectes), IN PLANKTON COLLECTIONS FROM CRUISES OF M/V Theodore N. Gill SOUTH ATLANTIC COAST OF THE UNITED STATES, 1953-54

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ABSTRACT

During the course of nine *Gill* cruises, plankton was collected at 80 regular stations between Jupiter Light, Fla., and Cape Hatteras, N.C., from near the beaches to beyond the axis of the Gulf Stream, and from 9 special stations farther offshore. Subsamples were taken from selected collections and examined for *Callinectes* larvae. The presence of early stage zoeae indicated that spawning occurred throughout the year in Florida waters, but subsided during winter months in waters north of Florida. Early stage zoeae were captured at temperatures from 16.4° to 29.2° C., with peak numbers taken from May to November at 27.0° to 29.0°C., depending on the area. Early stage zoeae occurred in abundance near the beaches, advanced stage zoeae and megalops were more common offshore, while combined larval stages were found in greatest numbers at the 20-mile offshore stations.

INTRODUCTION

The identity and distribution of crabs, genus *Callinectes* occurring along the coast of the Southeastern United States are uncertain. Four crabs of this genus are known to occur in this area. They are *C. sapidus*, *C. ornatus*, *C. danae*, and *C. marginatus*. Rathbun (1930) described each of these species and reported that the northern limits of their ranges are: *C. sapidus*, Cape Code, Mass.; *C. ornatus*, New Jersey; *C. danae*, Indian River Inlet, Fla.; and *C. marginatus*, the Florida Keys. Lunz (1958) reported that the morphological features usually given for taxonomic separation of the latter three species are quite variable, and individuals matching any of the frontal outlines given by Rathbun can be found in South Carolina waters. Also, Lunz reported that only about 30 percent of the crabs caught by trawlers on the South Carolina coast are *C. sapidus*. The remainder belong to another species of *Callinectes*, presumably *C. ornatus* (but possibly *C. danae*). Relatively large numbers of *C. sapidus*, and presumably *C. ornatus*, are taken in trawler catches on the North Carolina coast. Nonselective gear catches in the St. Johns River, Fla., are composed of *C. sapidus* and *C. ornatus*, but possibly *C. danae* or a combination of all three *Callinectes*.

Hatching and development of some *Callinectes* species are known to occur along the coastal area of the South Atlantic States. Lunz (1958) reported that egg-bearing females, presumably *C. ornatus* (but possibly *C. danae*), were trawled along the South Carolina coast in May, August, and September at temperatures ranging from 24° to 29° C., in salinities between 26.5 and 30.6 parts per thousand (‰). There were indications that spawning took place offshore and extended over a

long period. Van Engel (1958) reported that mating of *C. sapidus* began in early May and continued into October in the Chesapeake Bay. After hatching, the larvae passed through a number of zoeal stages and a megalops stage, before they had the form of a crab. Also, Van Engel reported that the zoeal form lasted about a month, during which time it molted at least four times. Hopkins (1944) suggested that there may be a fifth stage zoea, and Snodgrass (1956) reported that perhaps there was a sixth stage zoea preceding the megalops stage. In the laboratory, Costlow and Bookout (1959) observed that *C. sapidus* had seven zoeal stages and one megalops before it reached the first crab stage. An eighth zoeal stage was sometimes observed but usually did not complete metamorphosis to the megalops. Development to the megalops required a minimum of 31 days and a maximum of 49 days. The megalops stage lasted from 6 to 20 days depending on the salinities used.

To obtain information on the spawning season and the number of larval molts of *Callinectes* crabs and to determine the offshore distribution and abundance of the larval forms in the areas cruised by the Bureau of Commercial Fisheries research, vessel *Theodore N. Gill*, we examined the plankton collected by that vessel on nine cruises over a 2-year period, 1953-54. This study is a part of an investigation by the Bureau of the blue crab *C. sapidus* along the South Atlantic coast of the United States.

METHODS

The basic station plan for all cruises of the *Gill* has 80 regular stations between Jupiter Light (Florida Straits) and Cape Hatteras extending from near the beaches to beyond the axis of the Gulf Stream and 9 special stations farther offshore (fig. 1). The regular stations were 20 miles apart on the east-west line, 40 miles apart in the north-south direction, with some stations established inshore between the east-west lines. Nine cruises were made from January 1953 to December 1954; all varied from the basic plan (table 1). The physical oceanographic, biological, and chemical data were published in a series of reports (Anderson and Gehringer, 1957a, 1957b, 1958a, 1958b, 1959a, 1959b, and 1959c; Anderson, Gehringer, and Cohen, 1956a and 1956b). Biological methods and procedures and other pertinent information were given in those reports.

To examine the plankton samples from the *Gill* cruises for *Callinectes* larvae a 40-ml. subsample was taken from each sample (table 2). Then, three 4-ml. aliquots were taken from each subsample, and the *Callinectes* larvae removed with the aid of a binocular microscope. The number of larvae at each stage was recorded and stored for future reference. Finally the larvae in each 4-ml. aliquot were combined. Identification of *Callinectes* type larvae was based on Costlow and Bookout (1959) and unpublished work by the Bureau of Commercial Fisheries Biological Laboratory, Beaufort, N.C.

OCCURRENCE OF *Callinectes* LARVAE

Early stage *Callinectes* zoeae were more common than the advanced stage zoeae, though all eight stages and the megalops were present. The most productive sections for the combined larval forms were Matanzas and Jacksonville, Fla.; Savannah, Ga.; Charleston, S.C.; and Cape Fear, N.C. (fig. 2). The number of larvae at each stage in each area in the combined 4-ml. aliquots, is listed in table 3 by cruise and station number. The east-west distribution of larvae at each stage is listed in table 4 by month with temperature, salinity, and depth of capture ranges.

In general, larger numbers of early stage zoeae were collected near the beaches with a progression to advanced stage zoeae occurring 20 and 40 miles offshore, and the megalops in greatest numbers were 40 or more miles offshore (figs. 3 and 4). In Florida and Georgia early stage zoeae and the megalops were collected each month, while late stage zoeae were collected only from April to October (fig. 5). In South Carolina and North Carolina early stage zoeae were collected from May to December, late stage zoeae from July to September, and megalops from January to December (fig. 6).

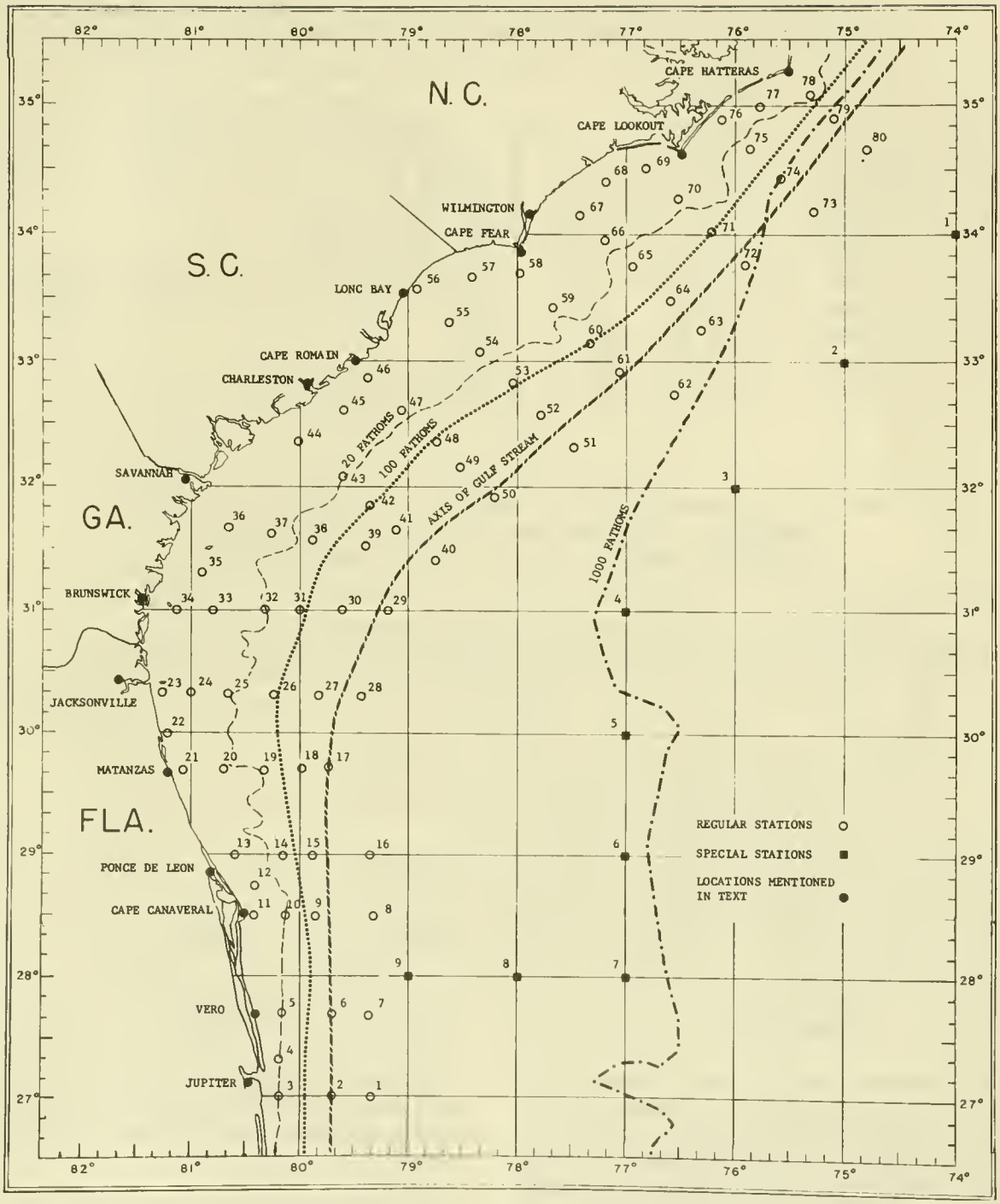

Figure 1.--Basic station plan *Theodore N. Gill* cruises, 1953-54.

Other crab larvae noted from all collections were *Polyonyx* sp., *Emerita* sp., *Ilepatus* sp., *Portunus* sp., *Panopeus* sp., *Eurypanopeus* sp., *Neopanope* sp., *Menippe* sp., *Rhithropanopeus* sp., *Pinnotheres* sp., *Dissodactylus* sp., *Pinnixa* *Sesarma* sp., *Uca* sp., and *Leucosiidae* plus some which resembled the Japanese genus *Ethusozoea.* Also some larvae were present which could not be identified.

Table 1.--Cruises of the *Theodore N. Gill*, with unoccupied stations listed by number, South Atlantic coast of the United States, 1953-54

Cruise	Date	Unoccupied stations
1--------	Feb. 10 - Mar. 10, 1953	9, 10, 12-22, 27-31, 63-68, 76, 78-80
2--------	Apr. 16 - May 15, 1953	50-52
3--------	July 15 - Aug. 16, 1953	73, 74, 78-80
4--------	Oct. 1 - Nov. 14, 1953	17, 71-74, 78-80
5--------	Jan. 20 - Feb. 25, 1954	27, 29-32, 45-57, 60, 72-74, 78-80
6--------	Apr. 14-29, 1954	18-80
7--------	June 9 - July 13, 1954	75
8--------	Aug. 27 - Oct. 1, 1954	40-42, 76
9--------	Nov. 3 - Dec. 12, 1954	31-34, 64, 73-80

Table 2.--Plankton samples examined for crab larvae, genus *Callinectes* from *Theodore N. Gill* cruises, South Atlantic coast of the United States, 1953-54

Cruise	Samples by station number	
	Regular	Special
1------	3, 4, 11, 24, 25, 32, 35, 38, 47, 59-71	---
2------	1-49, 53-78, 80	1-9
3------	1-42, 44-61, 63-72, 75-77	5-9
4------	1-16, 18-43, 45-50, 55-58, 67-69	5
5------	4, 6, 10, 12-14, 19, 20, 25, 37, 48, 54, 55, 66	5
7------	1-49, 51-74, 76-80	5-9
8------	1-7, 9-39, 43-63, 65-75, 79-80	---
9------	10, 13, 19, 20, 23, 24, 36, 37, 43-46, 51, 54,56-58,67,71	---

DISCUSSION

The spawning period, under natural conditions, of the four *Callinectes* species occurring on the southeastern United States is not definitely known. The occurrence of early stage larvae in plankton collections from the *Gill* cruises indicates that spawning occurs throughout the year (figs. 5 and 6). Based on the limited range of each species as given by Rathbun (1930), the early stage larvae found from February to November in Florida waters probably included *C. sapidus* and *C. ornatus*, with possibly *C. danae*. The early stage larvae found from April to September or from May to November, depending on the area, in Georgia, South Carolina, and North Carolina waters probably was a combination of *C. sapidus* and *C. ornatus*. This, in general, may indicate a difference in spawning period between areas or differences among species in the same area in spawning time and length of spawning period.

The temperature and salinity tolerance of *Callinectes* larvae are uncertain. Costlow and Bookout (1959) successfully hatched *C. sapidus* in the laboratory at temperature-salinity combinations of 20°, 25°, 30° C., and 21.1 to 32.0 ‰. The presence of first stage larvae in plankton samples from the *Gill* cruises indicates successful hatching by one or more of the species over a wide range of temperatures--from 18.1° to 29.2° C., in Florida waters,

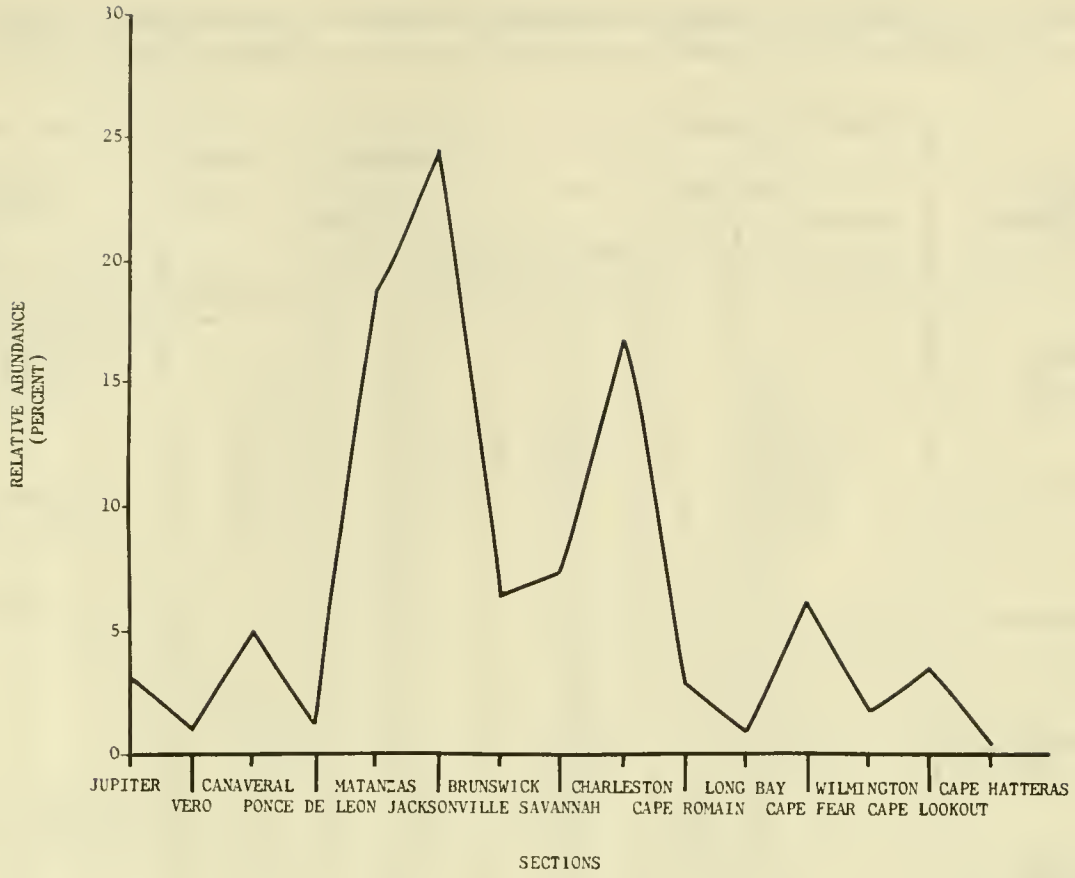

Figure 2.--Relative abundance of *Callinectes* larvae (combined stages) by area collected by *Theodore N. Gill* cruises, South Atlantic coast of the United States, 1953-54.

from 19.7° to 29.2° C. in Georgia waters, and from 22.0° to 28.2° C. in South Carolina waters (table 4 and fig. 5). The minimum-maximum salinity, when the *Gill* cruise collections were taken, was 33.4-36.0 ‰. In general, peak spawning occurred in water 27° to 29° C.

Peak numbers of first stage larvae appeared in April, June, July, and November in Florida waters; July, August, and September in Georgia waters; and May, July, August, and September in South Carolina and North Carolina waters. This occurrence of early stage larvae by month, however, may only reflect the time at which tows were made.

Costlow and Bookout (1959) reported that mortality was highest during the first zoeal stages in all temperature-salinity combinations. Once the second molt had been completed, however, some of the larvae lived to metamorphose to the crab. In the *Gill* cruise material, the large numbers of early stage larvae indicate a similar mortality under natural conditions for early stage zoeae. Also, when several third and fourth stage zoeae were present, advance stage zoeae were usually found in the same collection.

Whether most spawning occurs near the beaches and zoeae develop offshore is uncertain. The abundance and distribution on the east-west line from the beaches to 60 or more miles offshore followed the same pattern at all stations in Florida, Georgia, and South Carolina. Large numbers of first and second stage zoeae occurred near the beaches, with progression to advanced stage zoeae occurring 20 and 40 miles offshore. Megalops were usually in greater abundance offshore 40 or more miles (fig. 4). In North Carolina waters

Table 3.-- *Callinectes* larvae, in plankton samples from *Theodore N. Gill* cruises, South Atlantic coast of the United States, 1953-54

State and section	Cruise	Station	Number of larvae								
			Zoea								Megalops
			1st	2d	3d	4th	5th	6th	7th	8th	
Florida:											
Jupiter.....	3,4	1	-	-	-	-	-	-	-	-	2
	1,2,3,8	3	65	6	-	-	-	-	-	-	-
	1,2,8	4	14	1	-	-	-	-	-	-	-
Vero.....	3,4,8	5	8	-	-	-	-	-	-	-	1
	4,5,8	6	-	-	-	-	-	-	-	-	15
	8	7	-	-	-	-	-	-	-	-	1
	3	[1] 9	-	-	-	-	-	-	-	-	2
Canaveral...	7	9	-	-	-	-	-	-	-	-	1
	2,3,4,8,9	10	86	-	-	-	-	-	-	-	2
	2	11	7	-	-	-	-	-	-	-	-
	2,3,8	12	45	-	-	-	-	-	-	-	-
Ponce de Leon	2,3,8,9	13	21	1	-	-	-	-	-	-	-
	2,4	14	11	-	-	-	-	-	-	-	-
	3,4,8	15	1	1	-	-	-	-	-	-	2
	4	16	-	-	-	-	-	-	-	-	1
Matanzas....	2	18	-	-	-	-	-	-	-	-	1
	2,3,9	19	1	5	-	-	-	-	-	-	1
	3,7,8	20	15	1	10	2	-	-	-	-	1
	2,3,4,7,8	21	112	79	-	-	-	-	-	-	-
	2,3,7,8	22	246	56	1	-	-	-	-	-	-
Jacksonville	2,3,7,8	23	146	5	-	-	-	-	-	-	-
	2,3,4,7,8,9	24	70	80	136	171	93	17	4	1	-
	1,2,4,8	25	9	4	16	6	4	1	-	-	4
	2,3,8	26	1	-	4	1	4	2	2	1	-
	3	27	-	-	-	-	-	-	-	-	1
	3	28	-	-	1	-	1	-	-	-	-
Georgia:											
Brunswick...	3	29	-	-	1	-	11	1	-	-	-
	3	30	-	-	-	-	-	-	-	-	1
	2,3	31	-	-	-	-	-	-	1	-	2
	7,8	32	1	-	-	-	-	-	-	-	1
	3,7,8	33	23	9	23	17	12	6	7	-	4
	2,3,4,7,8	34	25	1	-	-	-	-	-	-	1
	2,3,7,8	35	20	2	-	-	-	-	-	-	10
Savannah....	3,7,8	36	70	28	1	-	-	1	-	-	5
	3,8	37	8	24	40	31	15	5	17	7	-
	3,8	38	-	-	4	3	11	3	2	-	1
	8	39	-	-	-	-	-	1	-	-	-

See footnote at the end of the table.

Table 3.-- *Callinectes* larvae in plankton samples from *Theodore N. Gill* cruises, South Atlantic coast of the United States, 1953-54--Continued

State and section	Cruise	Station	Number of larvae								
			Zoea								Megalops
			1st	2d	3d	4th	5th	6th	7th	8th	
South Carolina:											
Charleston..	2,3,7	42	-	-	2	-	1	-	2	3	21
	7,8	43	-	-	1	-	1	-	-	-	1
	2,3,8	44	88	16	7	-	1	-	-	-	-
	2,3,8	45	323	8	-	-	-	-	-	-	-
Cape Romain.	2,3,8	46	69	8	1	1	-	-	-	-	-
	2,3,7	47	-	2	-	-	-	-	-	-	1
	7	48	-	-	-	-	-	-	-	-	1
Long Bay....	3,7	51	-	-	-	-	-	-	-	-	3
	8	52	-	-	-	-	-	1	-	-	-
	2	53	-	-	-	-	-	-	-	-	1
	2,5,7,8	54	1	-	1	-	2	-	-	-	4
	2,5,7,8	55	1	1	-	-	-	-	-	-	3
	3,7,8	57	8	1	-	-	-	-	-	-	4
North Carolina:											
Cape Fear...	3,7,8,9	58	143	4	-	-	-	-	-	-	8
	7,8	59	3	-	7	3	9	1	3	-	-
	3,8	60	-	-	-	1	-	-	-	-	1
	2,7	61	-	-	-	-	-	-	-	-	4
	7	62	-	-	-	-	-	-	-	-	1
Wilmington..	2	63	-	-	-	-	-	-	-	-	1
	3,7	64	-	-	-	-	-	-	-	-	2
	3	65	-	-	-	-	-	-	-	-	3
	2,8	66	2	8	-	-	-	-	-	-	2
	3,4,8,9	67	3	3	1	5	1	2	1	-	5
	2,7,8	68	7	3	-	-	1	-	1	-	-
Cape Lookout	2,3,7,8	69	3	9	9	4	6	4	2	-	1
	3,7,8	70	5	1	2	-	-	-	-	-	3
	3,8	71	-	-	-	-	-	-	-	-	2
	3,8	72	-	-	-	-	-	-	1	-	4
	7	73	-	-	-	-	-	-	-	-	1
	8	74	-	-	-	-	-	-	-	1	-
	2,3,8	75	-	-	-	-	-	-	-	-	5
	7	76	-	1	-	-	-	-	-	-	2
	2,7,8	77	23	3	1	-	-	-	-	-	1
Cape Hatteras	8	78	2	3	2	1	-	-	-	-	1
	8	79	-	-	-	1	-	-	-	-	-

[1] Special station

Table 4.--Number of each stage *Callinectes* larvae, in plankton samples from *Theodore N. Gill* cruises by area and month, South Atlantic coast of the United States, 1953-54

Temperature and salinity recorded for surface to 1 meter

State and area	Month	Temperature	Salinity	Depth of hauls	Number of larvae								
					Zoea								Megalops
					1st	2d	3d	4th	5th	6th	7th	8th	
Florida:		°C.	‰	Meters									
Beaches....	February	19.7-20.5	36.1-36.2	0- 8	28	3	-	-	-	-	-	-	-
	April	20.7-22.9	35.5-36.3	0- 8	107	-	-	-	-	-	-	-	-
	June	27.3-27.7	35.1-35.5	0-10	216	2	-	-	-	-	-	-	-
	July	27.1-28.2	35.4-35.9	Surface-27	154	143	1	-	-	-	-	-	1
	September	28.3-29.2	34.9-36.2	Surface-13	78	5	-	-	-	-	-	-	-
	October	26.4	34.7	0-17	2	-	-	-	-	-	-	-	-
	November	21.3	36.0	Surface	2	-	-	-	-	-	-	-	-
Offshore...	January	24.8	36.2	0-60	-	-	-	-	-	-	-	-	13
20 miles	April	21.1-24.9	36.1-36.3	0-38	6	2	-	-	-	-	-	-	1
	June	27.0-27.4	35.5-35.9	0-15	4	29	20	7	4	4	1	-	1
	July	27.4-27.7	35.8-36.0	0-25	1	3	78	105	54	1	-	-	-
	September	28.1-29.1	35.9-36.4	0-69	27	38	38	59	35	12	3	1	2
	October	24.5-28.0	33.5-35.9	0-65	20	-	-	-	-	-	-	-	1
	November	21.2-25.2	36.2-36.4	0-15	124	8	-	-	-	-	-	-	-
Offshore...	February	18.1	36.1	0-13	-	-	8	-	-	-	-	-	-
40 miles	April	21.6-25.8	36.1-36.3	0-67	-	1	4	1	2	1	1	-	4
	June	28.4	35.9	0-73	-	-	-	-	-	-	-	-	1
	July	27.7-29.3	35.8-36.0	0-65	-	-	-	-	2	1	-	-	3
	September	28.1-28.9	35.6-36.4	0-82	10	4	8	6	4	1	-	-	2
	October	25.9-28.0	35.8-36.0	0-69	1	1	-	-	-	-	-	-	3
	November	24.7	36.1	0-16	1	4	-	-	-	-	-	-	-
Offshore....	July	28.8	35.9	0-52	-	-	1	-	1	-	-	-	1
60 miles													

Table 4.--Number of each stage *Callinectes* larvae, in plankton samples from *Theodore N. Gill* cruises by area and month, South Atlantic coast of the United States, 1953-54--Continued

Temperature and salinity recorded for surface to 1 meter

State and area	Month	Temperature	Salinity	Depth of hauls	Number of larvae								
					Zoea								
					1st	2d	3d	4th	5th	6th	7th	8th	
		°C.	‰	Meters									
Georgia:													
Beaches....	April	19.7	34.7	0- 3	8	-	-	-	-	-	-	-	-
	May	22.1	34.6	0- 4	1	-	-	-	-	-	-	-	10
	June	27.8	34.7	Surface	1	-	-	-	-	-	-	-	-
	July	27.5-28.2	34.2-35.4	Surface-14	15	-	-	-	-	-	-	-	5
	August	28.7-29.2	34.8-35.2	0- 7	75	27	1	-	-	-	-	-	-
	September	28.0	35.7	Surface-5	15	4	-	-	-	1	-	-	-
	October	23.1	34.3	0- 8	-	-	-	-	-	-	-	-	1
Offshore...	June	27.6	35.0	0- 8	-	-	-	-	-	-	-	-	1
20 miles	July	27.7	35.9	0-22	3	2	5	-	1	-	-	-	3
	August	28.0	35.6	0-17	1	-	8	24	9	3	16	7	-
	September	28.0	36.2	0-13	27	31	50	24	17	8	8	-	-
Offshore...	June	27.5	35.7	0-15	-	-	-	-	-	-	-	-	1
40 miles	August	28.6	35.8	0-26	-	-	2	3	10	2	2	-	-
	September	27.2-27.5	36.1	0-24	1	-	2	-	1	1	-	-	-
Offshore...	April	22.7	36.3	0-43	-	-	-	-	-	-	-	-	2
60 miles	July	28.7-29.2	35.7-35.9	0-44	-	-	1	-	1	1	1	-	1
or more	September	26.8	36.0	0-86	-	-	-	-	-	1	-	-	-
South Carolina:													
Beaches.....	May	22.0-22.3	33.4-33.9	0- 4	124	-	-	-	-	-	-	-	-
	August	28.1-28.2	34.9-35.0	0- 8	326	6	-	-	-	-	-	-	-
	September	26.1-27.0	35.8-36.1	Surface	30	26	8	1	1	-	-	-	-
Offshore.....	February	14.3	35.4	0- 6	-	-	-	-	-	-	-	-	1
20 miles	May	22.3	33.7-34.5	0-11	1	1	-	-	-	-	-	-	-
	July	27.1-27.9	35.1-36.1	0-14	-	-	-	-	-	-	-	-	7
	August	28.1-28.2	34.4-35.7	Surface-20	-	1	-	-	-	-	-	-	1
	September	25.8-27.4	36.0-36.1	0-20	3	2	1	-	1	-	-	-	-

Table 4.--Number of each stage *Callinectes* larvae, in plankton samples from *Theodore N. Gill* cruises by area and month, South Atlantic coast of the United States, 1953-54--Continued

[Temperature and salinity recorded for surface to 1 meter]

State and area	Month	Temperature	Salinity	Depth of hauls	Number of larvae								
					Zoea								Megalops
					1st	2d	3d	4th	5th	6th	7th	8th	
		°C.	‰	Meters									
Offshore...	February	18.5	36.3	0-10	-	-	-	-	-	-	-	-	2
40 mile	May	22.0-22.1	34.2-34.8	0-70	-	-	-	-	-	-	-	-	5
	July	27.4-27.6	35.6-36.5	0-82	-	-	-	-	-	-	-	-	4
	August	28.9	36.0	Surface	-	-	2	-	1	-	2	3	64
	September	26.6-27.6	36.0-36.2	0-69	-	1	1	2	-	-	-	-	-
Offshore...	May	24.5	36.3	0-44	-	-	-	-	-	-	-	-	1
60 miles	July	27.4	36.0	0-77	-	-	-	-	-	-	-	-	1
or more	August	29.1	36.0	Surface	-	-	-	-	-	-	-	-	2
	September	27.2	36.1	0-60	-	-	-	-	-	1	-	-	-
North Carolina:													
Beaches....	May	20.0-21.1	34.6-35.6	0-10	18	-	-	-	-	-	-	-	-
	July	25.0-27.2	35.3-35.7	Surface-5	2	11	7	4	4	4	-	-	2
	August	27.3-27.7	35.6-36.0	0-10	1	-	-	-	-	-	-	-	5
	September	25.7-26.3	35.2-36.2	0-10	18	11	5	6	4	2	4	1	1
	November	18.9	35.5	0-10	1	-	-	-	-	-	-	-	4
	December	15.6	36.4	Surface	-	-	1	-	-	-	-	-	-
Offshore...	May	21.2	34.3-35.6	0-18	1	-	-	-	-	-	-	-	3
20 miles...	July	36.8-27.2	35.1-36.6	0-15	32	-	2	-	-	-	-	-	-
	August	24.4-28.3	35.6-35.8	Surface-19	103	3	-	-	-	-	-	-	11
	September	25.6-26.6	35.8-36.4	0-13	12	10	-	-	-	-	-	-	2
	December	16.4	36.5	0- 8	2	-	-	-	-	-	-	-	2
Offshore...	July	26.8	35.9	0-22	3	-	-	-	-	-	-	-	-
40 miles...	August	27.7-28.1	35.9-36.0	0-77	-	-	-	-	-	-	-	-	4
	September	25.3-28.2	35.9-36.3	0-65	-	-	7	4	9	1	3	1	1
Offshore...	May	24.0-25.0	36.2-36.3	0-64	-	-	-	-	-	-	-	-	2
60 miles	July	27.1-28.2	35.8-36.1	0-102	-	-	-	-	-	-	-	-	6
or more	August	27.6-28.7	35.8-36.0	0-52	-	-	-	-	-	-	-	-	5
	September	27.8-28.2	35.9-36.2	0-60	-	-	-	1	-	-	1	-	1

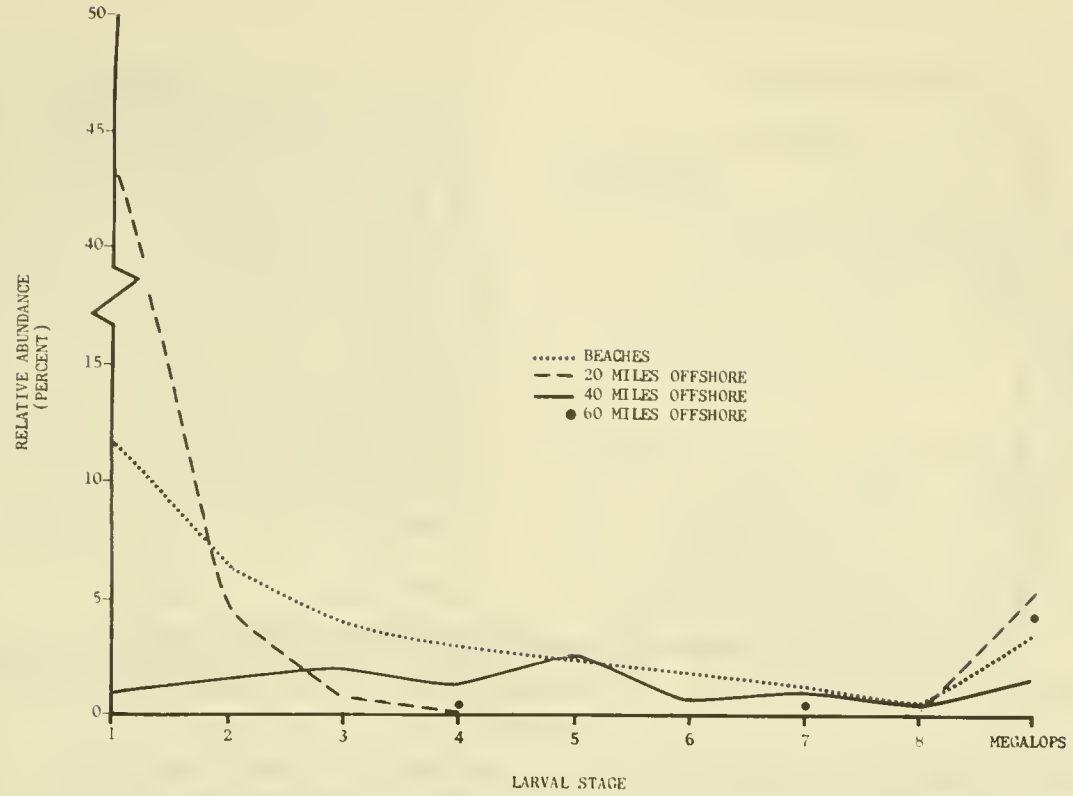

Figure 3.--Offshore relative abundance of larval stages of *Callinectes* in plankton samples from *Theodore N. Gill* cruises, North Carolina, 1953-54.

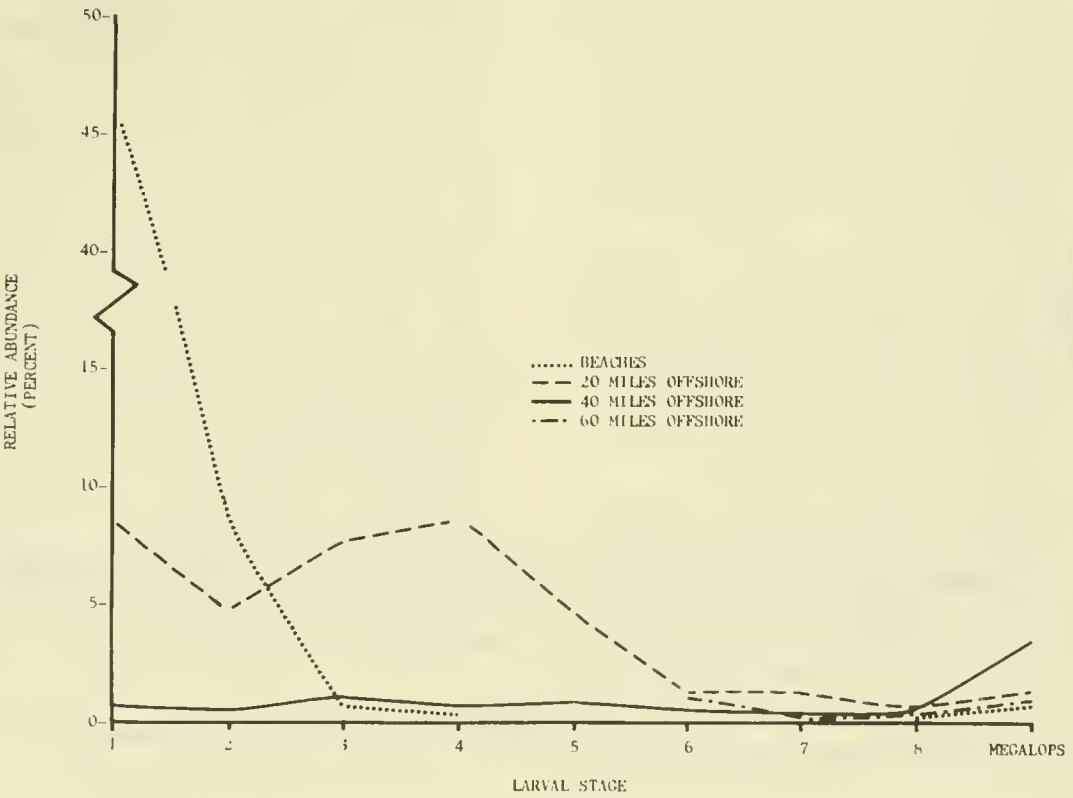

Figure 4.--Offshore relative abundance of larval stages of *Callinectes*, in plankton samples from *Theodore N. Gill* cruises, Florida, Georgia, and South Carolina, 1953-54.

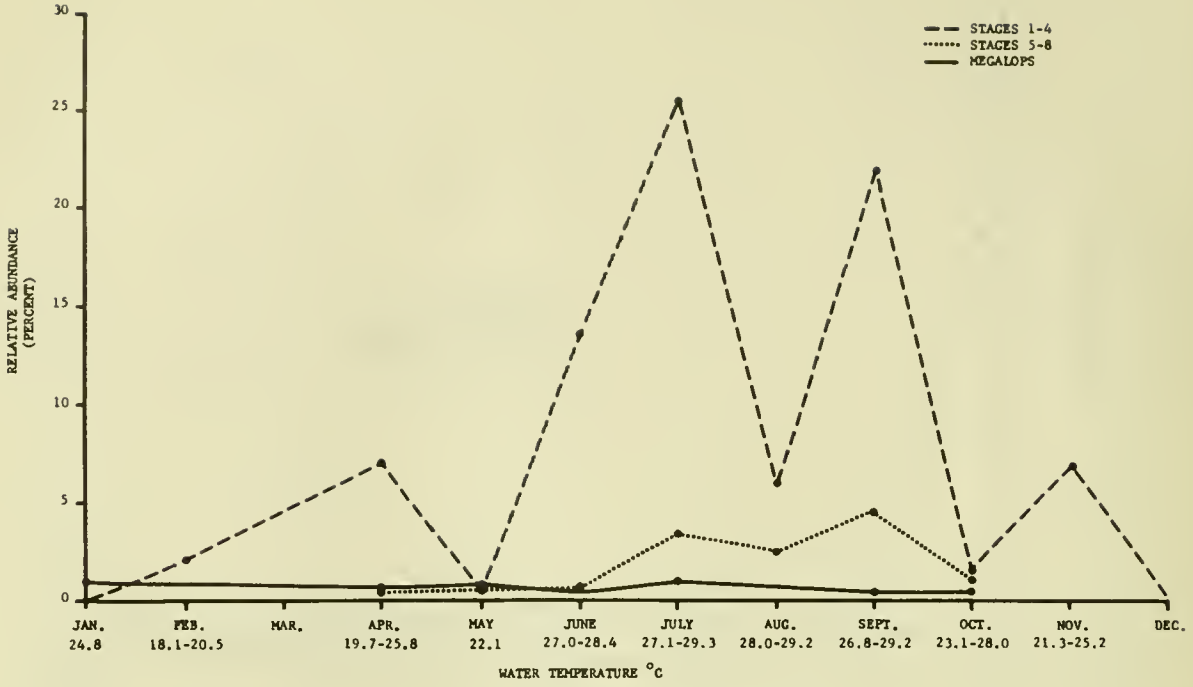

Figure 5.--Relative abundance of early and late stage zoeae and megalops, genus *Callinectes* by month in plankton samples from *Theodore N. Gill* cruises, Florida and Georgia, 1953-54.

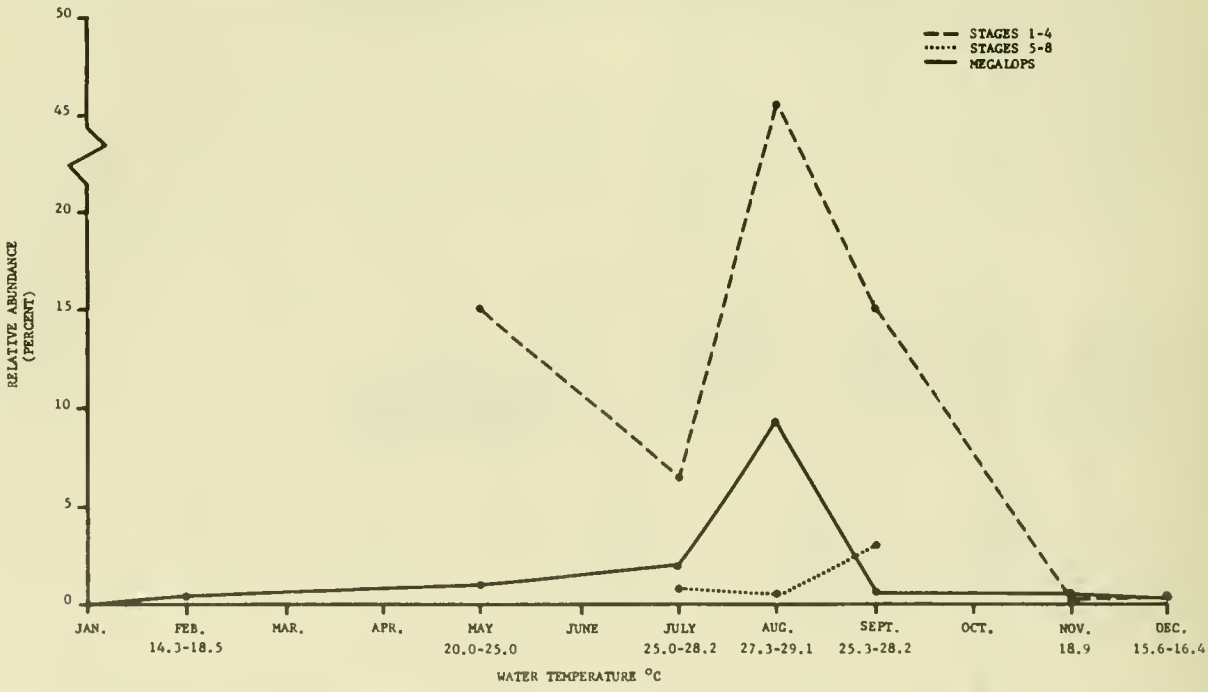

Figure 6.--Relative abundance of early and late stage zoeae and megalops, genus *Callinectes*, by month in plankton samples from *Theodore N. Gill* cruises, South Carolina and North Carolina, 1953-54.

large numbers of early stage zoeae occurred 20 miles offshore, and near the beach stations all stage zoeae and the megalops were found in relatively equal numbers (fig. 3). The 20-mile offshore stations were the most productive in the southern States, whereas in North Carolina the beach stations were the most productive. The reason for this difference is not known, though it may be a salinity or temperature combination or a current pattern. In North Carolina waters most beach stations were along the Outer Banks, separated from the mainland by sounds, whereas to the south the beach stations were adjacent to the mainland with fresh-water drainage emptying directly into the ocean.

Some differences were noted in comparing *Callinectes* larvae from *Gill* cruise collections to *C. sapidus* larvae at known stages of development (from the work of Costlow and Bookout). In some *Callinectes* a minute seta is present under the lateral spine on the telson at all stages of development, but this seta is absent on *C. sapidus*. A few of the advanced stage zoeae had slightly longer setae and longer exopodites on their antenna than *C. sapidus*. In others the lateral spines on the abdomen were slightly longer on the third segment from the telson, and the dorsal spine was straighter and longer than found on *C. sapidus*. In a few, the exopodite of the antenna varied in position from that of *C. sapidus*. In others 10 setae were present on the second maxilliped of the fourth stage zoeae instead of 9 for *C. sapidus;* a ninth spine on the inner margin of the telson on fifth stage zoeae instead of appearing on sixth stage *C. sapidus* zoeae; thoracic appendages extending below the carapace in sixth stage zoeae instead of seventh stage *C. sapidus;* and no setae on the pleopods in eighth stage zoeae as in *C. sapidus*. These inconsistencies may identify the presence of more than one *Callinectes* species and may be morphological features which can be used for taxonomic separation.

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